SUMMARY

Customers and competitors of the local exchange carriers (LECs) have proposed radical mid-course adjustments to the level of prices and the productivity offset in the current price cap plan, largely based on allegations that LEC earnings have been too high under the plan. The FCC price cap decision established an incentive regulation framework for LECs that provided an opportunity for LECs to attain reasonable results for their shareholders, while at the same time providing benefits to ratepayers in the form of guaranteed reductions in real telephone rates. Under the plan, the LECs were permitted--indeed, encouraged--to achieve returns greater than those associated with traditional regulation if their performance met and then exceeded the targets in the plan design. Conversely, the LECs assumed the risk if their performance (or if other events) produced substandard earnings.

One of the most fundamental premises underlying incentive regulation programs is the requirement that the program not be modified purely on the basis of actual outcomes under the plan. To do so would be to revert to a form of cost-plus rate of return regulation with all of its attendant incentive distortions. Nonetheless, some parties to this review have proposed reductions in LEC prices or increases in LEC productivity offsets precisely because earnings of some LECs have increased or exceeded the expected level established by the price cap decision.[1]

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[1]For example, in discussing proposed changes to the price cap formula, AT&T (p. 23), characterizes the fact that RBOCs have done reasonably well under the plan as evidence of excessive prices justifying an increase in the productivity offset:

> The Commission's tentative proposal to increase the LECs' productivity offset is amply justified by the record of those carriers' performance under incentive regulation...The LECs' productivity factor should therefore be revised upward from its current level to reflect the higher value confirmed by actual LEC experience...

In fact, the price cap plan offered the LECs the opportunity to just earn their cost of capital if they met the productivity target and to do better if they exceeded the target. The successful response of some LECs to these incentives is an indication of the strength of the current plan, not its failure.

In fact, the plan recognized a wide range of acceptable earnings outcomes, ranging from a floor at 10.25 percent to a 50/50 sharing point at 12.25 percent to a cap at 16.25 percent. According to AT&T, averaged over the 1/91 to 12/93 period, no RBOC rate of return fell outside this range. Adjusting the plan on the basis of actual outcomes that are clearly within the range contemplated by the plan would simply be a return to the bad old days of traditional cost-based regulation, which the Commission rightly rejected as antiquated and in need of change.

Because of the uncertainty inherent in a new form of regulation, the Commission scheduled a review to provide an opportunity to correct the parameters of the plan if outcomes wandered far off course. Accordingly, the Commission's decision in CC Docket No. 87-313 established its broad range of acceptable outcomes as part of the design of the plan. Mid-course corrections, if any, would not be applied to outcomes in the acceptable range so that the review would not destroy or dilute the very incentives for which the shift to price cap regulation was intended. Unfortunately, parties currently propose to adjust price cap indices or productivity offsets to reduce LEC earnings to 11.25 percent or lower. Such proposals are best described as attempts to turn back the clock to rate of return regulation as if the Commission's decision in CC Docket No. 87-313 had never taken place. Rather than accept the fact that the Commission actively encouraged the LECs to increase earnings, the LECs' competitors and large customers use this desirable outcome to indict the plan itself. If accepted, the result of these proposals would be a dismantling of the incentive regulation plan that the Commission so carefully crafted.

ECONOMIC PERFORMANCE OF THE LEC PRICE CAP PLAN: REPLY COMMENTS

Two key economic questions in the review of the local exchange carrier (LEC) price cap plan are whether mid-course adjustments to LEC price cap indices (PCIs) or to the annual productivity offset X are warranted. If the initial rates were set properly, LECs entered the price cap plan with rates set to recover prudently-incurred economic costs. If the productivity offset were set correctly, the economic theory of price cap regulation[2] shows that LEC revenue would increase more slowly than economic costs unless the LEC achieved the productivity growth implicit in the productivity offset. Thus the LEC's prices would deviate from costs only to the extent that its productivity growth deviated from the target, so that increases (or decreases) in economic earnings would be directly tied to exceeding (or falling short of) the productivity offset.[3] In the Notice of Proposed Rulemaking of its review of LEC price cap regulation, the Commission contemplated changes in these two parameters in light of the LEC experience under price cap regulation:

> Baseline Issue 3a: Whether the productivity factor used to compute the LEC price cap indices should be changed; in addition...whether a one-time change in the LEC's price cap index should be required...(a)s a further alternative, whether the Commission should adopt a mechanism which would adjust the plan to reflect changes in interest rates...[4]

The United States Telephone Association has asked us to respond to comments filed on these issues.

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[2] As explained in our initial comments at pp. 1-11.

[3] Note that earnings as measured by regulatory books of account differ from economic earnings. In particular, as discussed below in Section I.E, the difference between regulatory accounting and economic asset lives creates a significant distortion in LEC accounting earnings and measured rates of return.

[4] Notice of Proposed Rulemaking, CC Docket No. 94-1, released February 16, 1994, ¶ 46.

Some non-LEC commentors urge the Commission to reduce current and future access prices through a one-time reduction in the PCIs and/or the adoption of a higher productivity offset X. A one-time reduction in the PCIs is proposed as a mechanism to account for the decline in interest rates and the LECs' cost of capital over the price cap period, or a higher value of X is claimed to be required by studies of LEC productivity or the observation that future productivity growth will exceed historical productivity growth. In these comments, we show that the LEC productivity experience under price cap regulation supports, if anything, a reduction in the productivity target. The productivity studies--and adjustments to those studies-- cited by commentors are incorrect, have been misinterpreted, or apply to something other than the LEC price cap plan as adopted by the Commission. If the Commission were to update the LEC productivity offset for more recent data, using exactly the same method it used in CC Docket No. 87-313, it would obtain a short term X of 2.7, a long term X of about 2.1, and an overall productivity offset of 2.4 percent. The analyses by AT&T and GSA of the productivity growth implied by LEC earnings are flawed because changes in accounting earnings do not correspond directly to changes to productivity.[5] In particular, historic measures of earnings are based on historic accounting depreciation rates, and a price cap plan intended for use in a future characterized by increasing levels of competition must rely on more realistic economic asset lives. In addition, one-time adjustments to the price level to account for changes in interest rates are clearly not--and should not be--part of the price cap plan, and, even if they were, proposals to rebench price cap rates to reflect an alleged lower cost of capital fail to account for changes in the prices of other factors of production and for the double-counting of input price changes to the extent that (i) they are already captured in national inflation

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[5] In general, accounting earnings differ from economic earnings, and changes in economic earnings do not necessarily reflect changes in productivity growth. For example, all else equal, an increase in wage rates will reduce measured earnings but will have only a minor effect on TFP growth through the change in input expenditure weights.

(GNP-PI) and (ii) their historical long-run average differential is already embedded in the X measured by the Commission.

I. The Productivity Offset (X) Should Not Be Increased

There are three mechanisms by which some commentors seek to increase the productivity offset X. First, AT&T, MCI, Ad Hoc and GSA make direct and indirect claims that LEC productivity growth has exceeded the target implicit in the current X of 3.3 percent and conclude that X must be increased in order to flow the benefits of higher productivity growth through to customers.[6] Second, Ad Hoc, relying on an ETI study[7] claims that input price growth has been lower for the LECs than for the economy as a whole, and that X should be increased to account for that difference. Finally, ETI asserts that an addition to the offset should be made to give consumers a productivity dividend, in the same manner as the Commission's Decision in CC Docket No. 87-313 added a Consumer Productivity Dividend (CPD) of 0.5 percent to X in order to share the benefits of adopting incentive regulation with consumers.[8] In addition to these measurement issues, there are proposals to increase X to account for a variety of alleged infirmities in the price cap plan, including the LECs' increased rates of return under price caps, the dependence of the Commission's initial setting of X on the 1984/85 data, a comparison of the current X with productivity targets from selected state price cap plans, the lower-than-expected rate of growth in usage per line, or the claim that

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[6]See AT&T at pp. 22-28, MCI at pp. 22-25, Ad Hoc at pp. 18-24, and GSA at p. 8.

[7]ETI, "LEC Price Cap Regulation: Fixing the Problems and Fulfilling the Promise," (the "ETI study") Attachment A to the Comments of the Ad Hoc Telecommunications Users Committee, CC Docket No. 94-1, May 9, 1994.

[8]ETI Study at p. 55.

future productivity growth will outstrip historical productivity growth. None of these arguments offers a valid basis for an upward adjustment of the productivity offset.

A.   Background

In a study appended to its comments, Ad Hoc recommends that X be increased to at least 5.8 percent, based on its estimated average LEC total factor productivity (TFP) growth of 3.8 percent, an alleged difference between LEC input price growth and GDP-PI growth of 1 percent, plus a recommended 1 percentage point consumer productivity dividend.[9] In order to assess this recommendation and place other recommendations in perspective, it is useful to identify how and why Ad Hoc's recommended productivity offset departs from 3.3 percent. In our opening comments, we observed that the productivity factor represents (i) the difference in LEC and U.S. economy-wide TFP growth offset by (ii) expected differences (if any) between the rates of growth of input prices of the LEC and the U.S. economy:[10]

$$X = (dTFP - dTFP^N) - (dw - dw^N)$$

where $dTFP$ and dw represent the annual change in LEC TFP and input prices and $dTFP^N$ and dw^N represent the same annual changes for the U.S. economy as a whole.

In establishing X in CC Docket No. 87-313, the Commission used three types of information. First, it directly used (indeed, averaged) results of two studies of output price

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[9]TFP growth is the difference between the growth of output and the growth of inputs required to produce that output. It is the most inclusive--and most appropriate--measure of efficiency improvements for a firm, an industry, or a nation. Input prices are the prices paid by the firm for the services of labor and capital and for raw materials. GDP-PI is the fixed weight price index for the commodities which make up U.S. gross domestic product and is a measure of U.S. output price inflation. In the initial LEC price cap plan, national inflation was measured using the fixed weight price index for the commodities making up U.S. gross national product (GNP-PI). Because the GDP-PI has become the primary measure of U.S. inflation, and because the two measures are virtually identical in practice, most parties to CC Docket No. 94-1 advocate replacing the GNP-PI in the annual price cap adjustment formula with the GDP-PI.

[10]"Economic Performance of the LEC Price Cap Plan," Attachment 5 to the Comments of the United States Telephone Association, CC Docket No. 94-1, filed May 9, 1994, pp. 8-9.

growth for the telecommunications industry or LEC carrier access services and the economy as a whole.[11] Because the calculation of X in this approach is a direct comparison between output prices, both effects--differential TFP and any differences in output prices--are automatically included. X, as estimated by the Commission, is an estimate of the historical difference in TFP growth rates (between the telephone industry and the U.S.) plus the historical difference in input price growth rates. Thus, to the extent that LEC input prices have grown any differently than U.S. average input prices, those differences were already included in the two studies relied upon by the Commission. Thus, ETI is simply wrong where it asserts that

> In formulating the X factor, the Commission did not specifically analyze the trends in LEC input prices relative to the GNP-PI. Instead, the calculation relied critically upon an *assumption* that LEC input prices rise faster than the GNP-PI. This assumption resulted in the "differential" productivity offset concept, which subtracts out national economy productivity from the actual LEC productivity to calculate the productivity offset....This LEC *assumption*, which is embedded in the 3.3% offset, can now be tested using actual LEC data. (footnotes deleted)

In fact, the Commission's method--the Spavins-Lande and Frentrup-Uretsky studies--made no assumption whatever about input price growth but rather measured X directly from output price data. The X, so measured, is equal to the historical productivity differential (between telecommunications and U.S. industry) less the historical difference (if any) in the input price growth rates.

Second, a host of direct TFP studies were cited as corroborative by the Commission in CC Docket No. 87-313, and these studies show annual telecommunications industry average TFP growth rates in the 2 to 3 percent range, corresponding to a telecommunications

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[11] The X of 3.3 percent was derived by adding a consumer productivity dividend of 0.5 percentage points to the historical average X of 2.8 percent, calculated as the numerical average of (i) the long term Spavins-Lande study of the real growth rate of telephone output prices and (ii) the short term Frentrup-Uretsky study of the real growth rate of LEC carrier access prices.

productivity differential in the 1 to 2 percent range.[12] Third, contrary to Ad Hoc's false claim

that the Commission and productivity experts <u>assumed</u> that the input price growth differential

was zero, it was shown that the input price growth differential was <u>in fact</u>, zero when measured

over a reasonably long period of time.[13] This fact is significant, because as we will observe

later, calculated input price growth rates are very unstable and measurements over short periods

of time are statistically unreliable.

B.   Productivity Studies

Contrary to Ad Hoc's claim that it has examined nationwide TFP, it has actually

produced TFP estimates from only seven states: California, New York, Pennsylvania, Delaware,

Illinois, Indiana, and Ohio.   These seven states account for only about one-third of the

population and exclude entire price cap LECs (for example, U.S. West, BellSouth, Southwestern

Bell and SNET are not represented among these states).[14] This defect notwithstanding--and even

before correcting for errors in the analysis--we note that Ad Hoc's productivity finding is

roughly consistent with the evidence the Commission evaluated when setting the initial target

in the price cap plan: LEC TFP growth in the 2 to 3 percent range and a productivity offset

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[12]<u>Second Report and Order</u>, (the <u>Price Cap Order</u>),   CC Docket No. 87-313, released October 4, 1990, ¶ 77.

[13]See, e.g., AT&T's <u>Comments</u> in response to the FCC's <u>Notice of Proposed Rulemaking</u> in CC Docket No. 87-313 (filed October 19, 1987), Appendix F or "Productivity Offsets for LEC Interstate Access," NERA study filed by the United States Telephone Association in CC Docket No. 87-313, (June 8, 1990).

[14]Three of the seven TFP studies cited by ETI were performed by Professor Christensen. His most recent LEC TFP study, filed as Attachment 6 to the United States Telephone Association's <u>Comments</u> in this proceeding, covers 48 states, representing 92 percent of LEC access lines in the U.S. It, too, finds annual LEC TFP growth in the 2 to 3 percent range, averaging 2.6 percent over the 1984-1992 period.

of about 2 percent.[15] Therefore, on the basis of the TFP information cited by Ad Hoc, there is no basis to conclude that the productivity offset needs to be increased.

1. Normal Variations in Productivity Growth

In our analysis attached to USTA's Comments, we observed that the difference between the telecommunications industry annual TFP growth and that of the U.S. (the "productivity differential") is highly variable--ranging from -5.6 percent to +6.8 percent over a 37-year period (p. 22). Rolling averages over longer periods, of course, exhibit less variability. If we examine three year averages (chosen because three years is the focus of the AT&T and GSA studies), the differential ranges from -1.3 to 5.4 percent with a standard deviation of 1.8 percentage points.

The fact that the difference between the actual productivity differential under price caps and the current productivity target is smaller than the standard deviation of three-year averages is of considerable importance.   Because of the inherent volatility of productivity growth, even a target that is correct, on average, is likely to be higher or lower than realized productivity growth on a year-to-year basis. Consequently, it is important to distinguish year-to-year fluctuations in the productivity differential (which are to be expected given the documented variability in productivity) from long term differences due to an error in setting the target. Resetting X every three years to track random statistical fluctuations in the achieved value of X would place the Commission's objective of preserving the efficiency incentives of pure price cap regulation would be placed in severe jeopardy.

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[15]ETI summarizes its review of TFP studies in Table 6, p. 59. We note that the TFP value given for Delaware (5.4 percent) differs from the value shown in the source document cited by ETI (3.5 percent). Use of the correct value reduces the average TFP for the seven states from 3.8 to 3.5 percent. See Direct Testimony of David J. Roddy before the Public Service Commission of the State of Delaware, PSC Regulation Docket No. 33, May 17, 1993, p. 16, and Supplemental Testimony of David J. Roddy before the Public Service Commission of the State of Delaware, PSC Regulation Docket No. 33, June 9, 1993, p. 4.

Efficiency incentives are preserved if realized productivity falls within a range determined by the natural fluctuation of annual productivity outcomes. For example, a standard conclusion from statistics is that actual outcomes that fall within one standard deviation of the expected outcome are consistent with the sampling error of the process. Thus, no action should be taken to change the productivity offset based on observations lying within a standard deviation of that offset. For deviations outside the range of statistical fluctuations, the Commission must still decide whether the deviation is due to success or failure of the incentives of price cap regulation or to an error in setting X. Resetting X to reflect short term deviations within the range of statistical fluctuations would not correct for an error in setting the target but rather would replace the incentives of price cap regulation with those of rate of return regulation with a three year lag.

2. Consistency with Other Productivity Studies

Two independent estimates of LEC industry productivity growth confirm that the current X was not an unreasonable productivity offset and that, if anything, the offset should be lowered. The TFP study conducted by L. R. Christensen[16] and an update of the methods used by the Commission to set the initial productivity offset (see Attachment 1) both confirm that the initial productivity offset exceeded its historical level by more than the Commission's announced CPD. According to the Christensen Associates study, annual TFP growth for the LEC industry for the period 1984 to 1992 averaged 2.6 percent. Since national TFP growth for the period averaged 0.9 percent and since there is no significant difference in the rates of growth of telecommunications and national input prices, the corresponding productivity offset

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[16]This study, Productivity of the Local Telephone Operating Companies, by Laurits R. Christensen, Philip E. Schoech and Mark E. Meitzen (the Christensen Associates study) was filed as Attachment 6 to the Comments of the United State Telephone Association.

from the Christensen Associates study is 1.7 percent. Also, our analysis shows that if the Commission were to use exactly the same procedures as were used in Docket No. 87-313, incorporating more recent data, the productivity offset would fall to 2.4 percent.[17]

3. **Consistency with Offsets in State Price Cap Plans**

The Pennsylvania Office of Consumer Advocate (PaOCA) is wrong in its selective use of productivity offsets in state price cap plans. The PaOCA reviews recommended decisions of Administrative Law Judges in Pennsylvania and California concerning productivity offsets for different intrastate price cap plans and concludes that "(t)he existing 3.3% and 4.3% inflation offsets are inadequate and understated" and that

> it would be appropriate for the FCC to increase the inflation offset consistent with recent data reviewed by the PaOCA and used by the administrative law judges in Pennsylvania and California.[18]

First, the preliminary findings of the administrative law judges in Pennsylvania and California cited by the PaOCA were not adopted by their respective Commissions. The cited X factor in Pennsylvania of 5.29 percent was changed to 2.93 percent and the cited California X factor of 6 percent was changed to 5 percent.[19] Hence the difference between the current X factor of 3.3 percent and those being adopted in state price cap plans is not nearly as large as indicated by the PaOCA.

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[17]See Attachment 1. No additional CPD--beyond that already embedded in the PCIs--is included in the productivity offset of 2.4 percent because the industry is not moving from traditional to incentive regulation as a result of this review.

[18]Comments of the Pennsylvania Office of Consumer Advocate, p. 7.

[19]Telecommunications Reports, Vol. 60, No. 24, June 13, 1994, p. 27. California Public Utilities Commission Decision (D.94-06-011), June 8, 1994.

Second, there is no logical connection between "inflation offsets" in state-specific incentive regulation plans and the productivity offset in the FCC price cap plan for LEC interstate access services. As the FCC observed,

> Several states have adopted productivity offsets in conjunction with incentive based regulatory plans. We note that California, for example, has adopted regulation centered around a price cap indexing mechanism that is adjusted annually according to the GNP-PI inflation index reduced by a productivity adjustment of 4.5 percent. See generally Before the Public Utilities Commission of the State of California, In the Matter of Alternative Regulatory Frameworks for Local Exchange Carriers (Decision 89-10-031), Interim Opinion (Oct. 12, 1989). We do not believe that the designation of a 4.5 percent productivity offset factor for intrastate services in California should bear significantly on our selection of a productivity offset to be used in a federal price cap plan for interstate access since the plans differ in significant respects. Just as the productivity of one operating company cannot be assumed to apply to an entire segment of the telecommunications industry, the productivity offset for California cannot be assumed to apply to the Nation as a whole.[20]

In general, productivity offsets in state plans are not directly comparable--with each other or with the FCC interstate access price cap productivity offset--because of differences in the structure of the plans, (e.g., the baskets, bands, pricing flexibility, price freezes, infrastructure investment commitments, sharing, service quality commitments) and because of the different mix of services covered by the plans (e.g., the basket of British Telecom services regulated by its price cap plan includes long distance and international calling).

4. Role of the 1984/85 Data Point

MCI claims that a productivity factor of 5.9 percent was warranted by the FCC's original studies in CC Docket No. 87-313:

> Correcting the analysis in the short term study to remove this data point would result in an upper bound of 5.43%...Thus the short-term productivity study measuring LEC productivity under rate of return

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[20]Supplemental Notice Of Proposed Rulemaking, CC Docket No. 87-313, Released: March 12, 1990, ¶ 106, footnote 191, page 53.

regulation from 1984 to 1989 would support a productivity factor of 5.9%[21]

First, MCI is literally wrong in describing a study that omits 1984/85 data as "a study of LEC productivity under rate of return regulation from 1984 to 1989." One cannot throw away the initial data point and still claim that the study applies to the entire period. More importantly, there is no evidence to support the elimination of the 1984/85 data point. This issue was raised previously by AT&T in CC Docket No. 87-313, and the FCC decided in that proceeding to retain 1984/85 data in the analysis.[22] Among the FCC's findings is a pointed rejection of AT&T's claim that 1984/85 data should be eliminated.

> A second major error in AT&T's historical analysis is its choice of a 1986 start year. (p. 44, ¶ 82)

> We are not convinced that the data available from [the 1984/85 period] is so unreliable as to be completely discounted. (p. 45, ¶ 83)

The Commission explicitly recognized that "events took place [in 1984/85] that will not, in all likelihood, be repeated" but went on to state that

> However, the effect of these changes can be evaluated and removed from the analysis in a manner that provides a more accurate picture of LEC productivity than if data from those years were omitted altogether. This is a technique common to all indirect price studies, including the ones performed by AT&T to determine LEC productivity. (p. 44, ¶ 82).

MCI presents no new information concerning the 1984/85 data beyond that which was available to the Commission in 1990.

a. **The 1984/85 Data Is Not An Outlier**

Extensive analysis was conducted by several parties in 1990 to evaluate whether the 1984/85 data point was an outlier. Three different models (log-linear, constant mean, and

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[21]Comments of MCI Telecommunications Corporation, p. 22.

[22]See the Supplemental Notice Of Proposed Rulemaking, CC Docket No. 87-313, Released: March 12, 1990.

linear) for three data series (common line, traffic sensitive and total switched access) were evaluated using conventional statistical tests, although only total switched access data were used to determine the historical value of the productivity offset for the Commission's plan. The unambiguous conclusion was that the 1984/85 data used to calculate productivity offsets for LEC switched access is not an outlier.[23] In spite of AT&T's allegations in the past and MCI's assertions today, it has been conclusively shown (and the Commission has accepted that showing) that the 1984/85 data point is not a statistical outlier.

b. Even If the 1984-85 Data Is Unusual, Ignoring It Would Be Wrong

Why should an observation not simply be ignored if it were clearly different from the other observations? The answer is simply that to ignore actual data is wrong. Data that *appears* unusual on the surface can nonetheless provide a great deal of information about the growth rate of (in this case) switched access prices even if the data appear not to be generated by an arbitrary simple model.

In particular, there is no reason to expect that switched access revenue per access minute should increase or decrease in a straight line, so that observing a data point that deviates from a straight line fitting the data tells us nothing about the accuracy of the data point. In addition, no analyst would believe a priori that switched access revenue per access minute should move over time in a straight line. There were a number of discrete events which affected the 1984/85 data and which must be part of any model of access prices in the post-divestiture period:

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[23]Statistical tests were conducted at the .05 significance level and for the more stringent .01 significance level. In both cases, it was concluded that the 1984/85 observation of total switched access was not an outlier. See Productivity Offsets For LEC Interstate Access prepared for The United States Telephone Association by National Economic Research Associates, Inc., filed with Reply Comments, CC Docket No. 87-313, July 8, 1990.

- The transitory effects of divestiture led to changes in the operating environment, requiring adjustments of unknown magnitude on the part of all companies involved.

- Economies of scale or scope or X-inefficiencies in the original Bell System may have led to a non-recurring gain or loss in productivity for the divested entities.

- The acceleration of equal access requirements required a more rapid conversion from electromechanical to electronic central office equipment. Since the old plant remained on the books, the early access periods saw increased depreciation expenses.

Although by simple visual observation the 1984/85 data point may appear low relative to the 1985/86 observation, there were clearly good reasons for this to be the case. And, as the Commission stated in the Supplemental Notice of Proposed Rulemaking, inclusion of such data "provides a more accurate picture of LEC productivity than if data from those years were omitted altogether."

5. **There is no Basis to the Claim that Future TFP Growth Will Exceed Historical TFP Growth**

ETI claims that telecommunications has enjoyed extensive cost-reducing and service-improving changes that provide the LECs with tremendous opportunities for productivity growth. Ad Hoc, relying on ETI, alleges that:

> In telecommunications, advances such as digital switching, fiber optic transport, and advanced signalling technologies, have provided LECs with enormous opportunities for productivity enhancements, translating into cost reductions which can, and should, be passed on to business and residential customers -- reductions which would be passed on under competitive market conditions. (Ad Hoc p. 20)

On this basis, Ad Hoc claims that the productivity offset should not be based solely upon historical productivity change but should also take account of *expected* changes from technology growth.

Ad Hoc's conclusion is entirely unsupported. There is no evidence presented and indeed no evidence available to support the allegation that telecommunications productivity growth will be greater in the future than in the past. This is not the first time that expected advances in telecommunications technology have been presented along with the insistence that their expected effects be included in the productivity offset. In CC Docket No. 87-313 the Commission evaluated a similar claim. The Commission's response was simple and to the point and still pertains to the current question.[24]

> Moreover, we do not agree with parties that contend that the Commission has overlooked significant potential productivity gains that will be realized through technological innovation in selecting its productivity factor. As a preliminary matter, while we agree that new telecommunications and data processing technologies will likely increase network efficiency and reduce the cost of providing telephone services, the impact of these advances on productivity has not been quantified by parties that make this argument. This aside, no data have been presented that refute the well established fact that the communications industry, since its inception, has been marked by technological innovation. This being the case, our productivity factor, based on the long-run historical experience of the industry, already reflects this characteristic. (p. 53, ¶ 107)

In keeping with the Commission's position, all of the evidence in this proceeding demonstrates that telecommunications productivity change relative to the U.S. economy is relatively constant over time. This fact is supported by all of the data presented in Attachment 5 to the Comments of the United States Telephone Association, as well as by the productivity study results presented in Table 6 of ETI's report on behalf of Ad Hoc.

Since about 1930, total factor productivity for telecommunications has consistently grown about 2 percent faster than TFP for the U.S. economy, and there is no evidence that supports the assumption that the future will be different from the past. During recent periods, post 1980, there can be little argument that the LECs have employed new technology. Most

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[24]See the Supplemental Notice Of Proposed Rulemaking, CC Docket No. 87-313, Released: March 12, 1990.

inter-office facilities are optical fiber, and fiber is rapidly diffusing into trunking and distribution facilities as well. The proportion of lines served from stored program control central offices has grown to virtually 100 percent, almost half of all central offices have digital technology, and the proportion of subscriber lines with SS7 technology has grown to almost 50 percent. If these types of technical change give rise to higher rates of TFP growth, one should therefore expect to see evidence of accelerated productivity growth for telecommunications over this period and a higher productivity differential.

In the following sections, we show that the average TFP differential has been about 2 percent over a very long period of time and that there is no indication that recent telecommunications TFP growth has been accelerated by recent changes in technology. If telecommunications TFP growth does not accelerate and U.S. TFP growth remains constant,[25] the productivity differential will not increase. Our conclusion is supported by productivity data derived from both direct and indirect measures of TFP growth.

a. Direct Measures of TFP Growth

Direct measures of the telecommunications productivity differential are available from several independent sources. The Bureau of Labor Statistics (BLS) calculates multi-factor TFP growth for the U.S. private business sector,[26] the American Productivity Center calculates TFP growth for the communications industry,[27] AT&T[28] and L.R. Christensen[29] have calculated TFP

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[25]The BLS has not released U.S. TFP growth estimates beyond 1990. Nonetheless, there are some suggestions that U.S. TFP growth is increasing since 1990. See, for example, John M. Berry, "Experience, Hard Numbers Part Company on Productivity," Washington Post, June 16, 1994 in which DRI is cited as forecasting a 1.3 percent TFP growth--higher than the 1985-1990 experience of 0.90--over the next decade. Increases in U.S. TFP growth--all else equal--make the telecommunications productivity differential smaller.

[26]For the period 1948 through 1990, the period over which the BLS indices are available, annual U.S. productivity growth averaged 1.4 percent.

[27]APC: American Productivity Center, Multiproduct TFP Growth, U.S. Private Business, Communications Industry.

growth for the Bell System, L.R. Christensen has calculated TFP growth for several LECs[30] and for the LEC industry[31], R.W. Crandall of the Brookings Institution has calculated TFP for the U.S. telecommunications industry,[32] and Jorgenson, Gollup and Fraumeni[33] calculated TFP for telephone, telegraph and miscellaneous communications. Overall, these measures of industry and national productivity growth show that the long run productivity differential averages about 2 percent per year.[34]

More important than the long run average productivity differentials reported above, once again these data reveal that there is no trend in TFP growth in recent periods. This can be seen in Figures 1 and 2, where we show the average productivity differential calculated over successive five-year periods, starting with the most recent period available and working backwards in time, using two of the direct measures cited above.[35] Figure 1 shows the telecommunications productivity differential combining L. R. Christensen's studies (1951-1987

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[28]AT&T: Bell System Productivity Study: 1947-1979, September 1980.

[29]L.R. Christensen, Testimony filed in United States v. AT&T, Civ. Action No. 74-1698 (D.D.C. filed November 20, 1974).

[30]e.g., L.R. Christensen, "Total Productivity Growth in the U.S. Telecommunications Industry and the U.S. Economy: 1951-1987," filed in North Dakota Public Service Commission Case No. PU-2320-90-149, October 1, 1990.

[31]Christensen Associates study.

[32]R.W. Crandall and J. Galst, "Productivity Growth in the U.S. Telecommunications Sector: The Impact of the AT&T Divestiture," The Brookings Institution, July 1990.

[33]D.W. Jorgenson, F.M. Gollup, and B.M. Fraumeni, Productivity and U.S. Economic Growth, Cambridge: Harvard University Press, 1987.

[34]Interestingly, a productivity offset of 2 percent is proposed in the FCC's price cap plan that regulates cable rates. Both the long run telephone TFP studies and the growing need for symmetrical regulatory treatment between competing telephone and cable companies would support a 2 percent productivity offset for the LECs.

[35]Any of the direct measures of industry productivity could have been used to show these points. We use the L. R. Christensen and R. W. Crandall studies simply because they both report results for the most recent annual periods.

Figure 1
The TFP Differential in the Christensen Studies
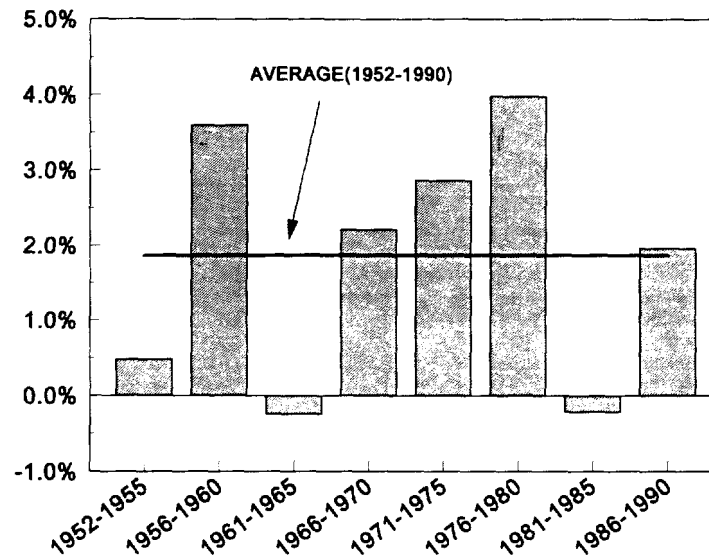
and 1984-1992).[36] Figure 2 shows the same result using R. W. Crandall's recent study for the 1960-1988 period.[37]

The new technologies cited by Ad Hoc as leading to an acceleration of productivity growth were well-established during the periods covered by these studies. By 1987, 85 percent of all central offices were using stored program control technology; in fact, 23 percent were using digital technology.[38] Despite such technical change, the data do not show such an acceleration in productivity growth because new technology has always been and will always

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[36]Even though LEC TFP growth is available through 1992 in the Christensen Associates study, we can only measure the differential through 1990 because U.S. TFP growth from the BLS is unavailable after 1990.

[37]Long run average differentials are 1.9 and 2.2 percent respectively and, once again, there is no indication of an increasing trend.

[38]Data taken from the FCC Statistics of Communications Common Carriers and from LEC filings in the 1990 FCC rate of return represcription docket (In the Matter of Represcribing the Authorized Rate of Return for Interstate Services of Local Exchange Carriers, CC Docket No. 89-624.)

Figure 2
The TFP Differential in the Crandall Study
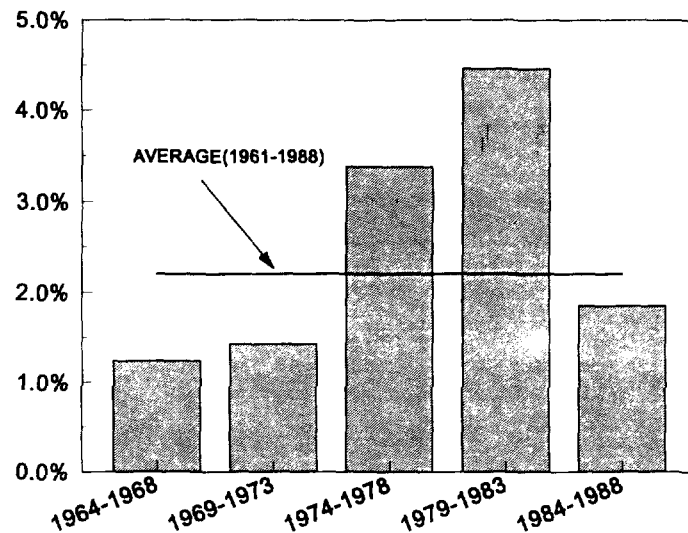
be introduced in the telecommunications industry. The data show that past advances in technology have affected productivity to roughly the same degree as the current stored-program control and digital switching, and optical fiber transport have affected productivity.

Finally, the Christensen Associates study filed as Attachment 6 to the Comments of the United States Telephone Association covers the more recent 1984 through 1992 period. Combining that data with current BLS data, the average differential for the five-year period ending in 1990--the most recent period for which BLS data is available--is also about 2 percent. Again, the data provide no support for the assertion that recent adoption of new technology has accelerated the rate of productivity growth in the industry.

In summary, despite the diffusion of new technology into the network, there is no quantitative evidence that the rate of growth of TFP has accelerated in telecommunications. To understand this finding, note that the measured diffusion of new technology in a network--as

experienced in digital switching and optical fiber transport--is inconsistent with a rapid growth in TFP. Analog offices will be replaced when the present value of the cost savings and revenue increases from a digital switch just outweigh the cost of conversion. In such a case, measured TFP would only increase marginally because adoption of the technology would only be marginally profitable. A second reason why LEC TFP growth may not be accelerating is that new productivity-enhancing technology is often embedded in the capital equipment installed in the network, and LEC investment is restricted by the artificially long asset lives established over decades of rate of return regulation. The key to competitiveness in the emerging global telecommunications marketplace is productivity growth, and in order for LECs to match the productivity growth of integrated, multinational telecommunications firms such as British Telecom or AT&T, they will have to have similar depreciation rates and asset lives. Third, while technology improvements may increase productivity, increased competition will reduce LEC output growth below what it otherwise would have been which, all else equal, will reduce LEC TFP growth below what it otherwise would have been.[39] Finally, if U.S. TFP growth increases--or even if it returns to its long-term average--the telecommunications productivity differential will decrease, making a fixed historical productivity offset more difficult to attain.

b. Other Productivity Studies

Results from seven empirical studies are reported in Table 6 of the ETI report attached to Ad Hoc's filed comments. ETI reports that the studies, originally commissioned by LECs and consumer groups, evaluate TFP growth over the 1984 to 1991 period. Three of

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[39]Chapter 2 of the Christensen Associates study finds that a one percentage point decrease in the rate of growth of intra-LATA toll and switched access demand would lead to a 0.21 percentage point decrease in annual TFP growth. In a previous econometric study, NERA found that a one percentage point decrease in the rate of growth of usage would lower TFP growth by about 0.39 percentage points (see NERA, "Analysis of AT&T's Comparison of Interstate Access Charges Under Incentive Regulation and Rate of Return Regulation," study filed on behalf of the United States Telephone Association in CC Docket No. 87-313, July 24, 1989).

the studies (California, New York, and Delaware) were conducted by ETI, three (Illinois, Indiana and Ohio) were conducted by L. R. Christensen, and one (Pennsylvania) was prepared by company staff. After correcting for a transcription error[40] the average TFP growth rate across all seven studies is 3.5 percent. The BLS estimates that TFP growth for the nation between 1984 and 1990 averaged about 0.9 percent, so the productivity differential, for this small sample selected by ETI, is about 2.6 percent.[41] As these post-divestiture studies obtain roughly the same results as studies of earlier periods, we conclude once again--this time using data provided by the ETI report--that there is no evidence of a secular increase in the productivity differential for the telecommunications industry.

c. Indirect Analysis of Productivity Growth

An indirect method of calculating the historical productivity offset for an industry is based on the difference between the rate of change of output prices for the industry and for the U.S. economy as a whole[42]. The economic theory of duality implies that the difference in TFP growth between the telecommunications industry and the nation as a whole can be calculated from the difference in their output price growth rates, adjusted for exogenous cost change differences.[43] Spavins and Lande used the CPI-U and CPI-Telephone to represent output price changes for the nation and the industry and found an average long-run productivity differential of 1.7 percent from 1929 to 1987. When data are updated to include 1993, this

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[40]The TFP value for Delaware should have been recorded as 3.5 percent rather than 5.4 percent as shown on Table 6 of the May 1994 ETI report prepared for Ad Hoc.

[41]The BLS has not yet made a 1991 estimate available.

[42]See the paper by Thomas C. Spavins and James M. Lande, "Total Telephone Productivity In The Pre and Post-Divestiture Periods", presented as Appendix D of the Supplemental Notice of Proposed Rulemaking, CC Docket No. 87-313, Released: March 12, 1990.

[43]See, for example, D.W. Jorgenson, "The Embodiment Hypothesis," The Journal of Political Economy, February 1966, pp. 1-17.

indirect approach reveals that the average productivity differential falls to 1.6 percent--evidence

that there has been no acceleration in productivity growth between 1987 and 1993.

Figure 3
The TFP Differential in the Spavins-Lande Study
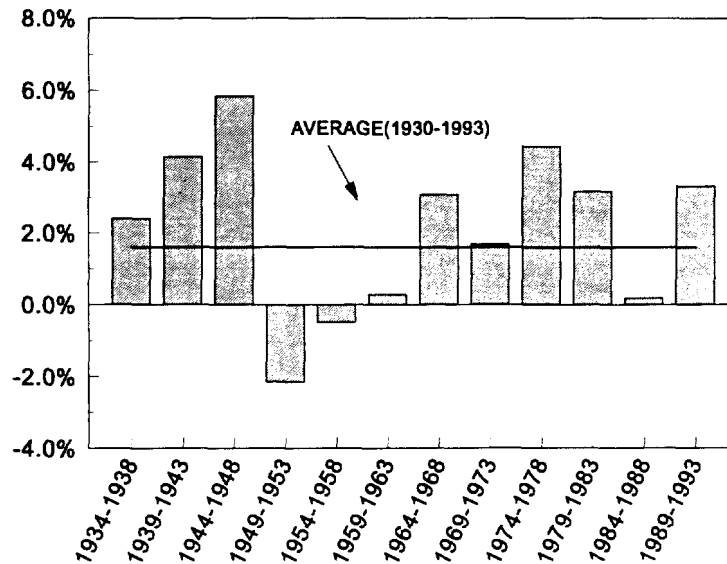
Examined carefully, these data do not show an increasing trend in recent years in

the productivity differential for the telecommunications industry: a trend, which, according to

ETI, should be found for at least recent periods when new switching and transmission

technologies have been put to extensive use in the network.   Figure 3 shows the average

productivity differential calculated over successive five-year periods from 1934 to the present.

Contrary to the allegations of Ad Hoc and ETI, there is no trend in the data; there is no

upsurge in productivity growth for the most recent five-year periods; in short, there is no

support for the assertion that the recent deployment of technology has accelerated the historical

rate of growth of TFP.

C.   Differences in Input Price Growth Rates

Ad Hoc asserts that LEC input prices have grown less rapidly than national inflation and thus--since national input prices grow at about 1 percent per year more rapidly than inflation[44]--LECs have received a windfall from the difference between the growth rates of their input prices and those of the nation as a whole.   At the outset, it is essential to understand that a possible difference in input price growth rates between the telecommunications industry and the U.S. as a whole (the "input price growth rate differential") may be relevant only when a productivity offset is calculated from a direct TFP study.   It is irrelevant if the productivity offset is calculated directly from output prices.   Recall that the productivity offset X is given by

$$X = (dTFP - dTFP^N) - (dw - dw^N)$$

so that if the input price growth rate differential ($dw - dw^N$) were important--and were expected to persist in the future--one would have to adjust the productivity differential ($dTFP - dTFP^N$) to calculate an appropriate X.   On the other hand, X can be estimated directly--without any reference to TFP growth or input prices--as the difference between telecommunications and national output price growth rates:

$$X = dP^N - dp = dGNP\text{-}PI - dp \quad .$$

Thus both components of X--the productivity differential and the input price growth rate differential--are automatically accounted for when X is calculated using the indirect, price-based method.   Since this method was used by the Commission in both the Spavins-Lande and Frentrup-Uretsky studies that were averaged to produce X, the validity of the current

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[44]Recall that for a firm, industry or nation for which the value of output remains equal to the value of input, input price growth is equal to output price growth plus the growth in total factor productivity.

productivity offset is unaffected by the outcome of the debate on the input price growth rate differential.

ETI asserts that LEC input prices have grown more slowly than GDP-PI by about 1 percent per year, amounting to an input price growth rate differential of about 2 percent. However, there are several problems with ETI's input price index that make it unreliable for its intended purpose.

1. ETI Uses an Incomplete and Unrepresentative Sample

ETI's claim that there is a consensus among post-divestiture TFP studies is both incomplete and misleading.

> "Empirical studies - conducted by economists who have pursued both LEC-sponsored and consumer group-sponsored analyses - have agreed that input prices grew at *less than GDP-PI* for the post-divestiture time frame." (p. 58)

In addition to the fact that ETI's seven states are inadequate to measure either national LEC productivity or input price growth, ETI systematically ignores studies that contradict its assertion. NERA, for example, performed a TFP study that is well-known to ETI for Pacific Bell which showed that LEC input prices grew slightly faster--but not statistically significantly faster--than U.S. input prices over the 1984 to 1992 time period.[45]

Further, ETI's own analysis did not show that input prices for California LECs grew more slowly than input prices for U.S. industry as a whole. Indeed, it showed the opposite. Using the ETI data and study results, we constructed the appropriate statistical test of the hypothesis that input prices grew at the same rate for California LECs and the U.S. economy as a whole during the 1985-1991 period. Table 1 shows input price changes for the U.S. as

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[45]William E. Taylor and Timothy J. Tardiff, "Economic Evaluation of the NRF Review: Reply Comments,"